

## CLAIMS

What is claimed is:

**[0085]** 1. A picture data signal embodied in a carrier wave for the reconstruction of video frames, said picture data signal comprising:

data blocks encoded using spatial correlation among the pixels (intra blocks);

data blocks encoded using both spatial and temporal correlation (inter or copy blocks); and providing identical reconstruction of said video frames even when different reference frames are used.

**[0086]** 2. The picture data signal of claim 1 wherein the value of each pixel  $S(x,y)$  in the inter or copy coded block is decoded as a weighted sum of a plurality of basis functions whose weigh values are obtained by quantization and dequantization of a plurality of reconstruction image coefficients formed using motion compensation prediction of this block constructed using previously transmitted and decoded pictures, received motion vectors and received quantized prediction error coefficients.

**[0087]** 3. A picture data structure for the reconstruction of video frames, said picture data structure comprising:

data blocks encoded using spatial correlation among the pixels (intra blocks); and

data blocks encoded using both spatial and temporal correlation (inter or copy blocks), and providing identical reconstruction of frames even when different reference frames are used..

**[0088]** 4. The picture data structure of claim 3 wherein the value of each pixel  $S(x,y)$  in the inter or copy coded block is decoded as a weighted sum of a plurality of basis functions whose weigh values are obtained by quantization and dequantization of a plurality of reconstruction image coefficients formed using motion compensation

prediction of this block constructed using previously transmitted and decoded pictures, received motion vectors and received quantized prediction error coefficients.

**[0089]** 5. A method of coding a switching picture S.sub.12 for switching from a first bitstream having a SP-picture S.sub.1 to a second bitstream having a second SP-picture S.sub.2, said method comprising the steps of:

copying the bitstream of the intra macroblocks in second SP-picture S.sub.2 to switching picture S.sub.12; and

encoding remaining macroblocks comprising the steps of:

forming a predicted frame for S.sub.12 by performing motion estimation with a plurality of reference pictures which are preceding S.sub.1 in said first bitstream;

calculating a set of transform coefficients for predicted image c.sub.pred by performing a forward transform;

quantizing the obtained transform coefficients to resulting in quantized coefficient levels; and

subtracting said quantized coefficient levels from a set of corresponding coefficient levels of said second SP-picture S.sub.2.

**[0090]** 6. A decoder for decoding encoded data wherein identical frames may be obtained even when they are predicted using different reference frames, said decoder comprising:

means for forming a prediction block P of a current block of data I using a plurality of motion vectors and a reference frame;

means for calculating a plurality of transform coefficients c.sub.pred for said prediction block;

means for calculating a plurality of quantized reconstruction coefficients I.sub.rec for said current block of data, wherein

$$l.sub.rec = (c.sub.pred \times A(QP1) + l.sub.err \times F(QP1, QP2) + f \times 2^{20}) // 2^{20}$$

$$\text{where } F(QP1, QP2) = (2^{20} \times A(QP1) + 0.5 \times A(QP2)) // A(QP2);$$

means for dequantizing said plurality of quantized reconstruction image coefficients, creating a plurality of dequantized coefficients  $d.sub.rec$ ; and

means for inverse transforming said plurality of dequantized coefficients.

**[0091]** 7. The decoder of claim 6 wherein means for calculating a plurality of quantized reconstruction coefficients  $l.sub.rec$  for said current block of data is comprised of:

means for calculating reconstruction image coefficients  $c.sub.rec$   
wherein

$$c.sub.rec = c.sub.pred + \alpha(QP2) \times l.sub.err,$$

wherein  $\alpha(QP2)$  is a quantization parameter dependent on the method of quantization and used QP value; and

means for quantizing said reconstruction coefficients creating a plurality of quantized reconstructed image coefficients  $l.sub.rec$ .

**[0092]** 8. The decoder of claim 6 or 7, further comprising means for normalizing said plurality of inverse transformed dequantized coefficients.

**[0093]** 9. The decoder of claim 8, further comprising means for filtering said plurality of normalized inverse transformed dequantized coefficients.

**[0094]** 10. A decoder for decoding a block of encoded data wherein identical frames may be obtained even when they are predicted using different reference frames, said decoder comprising:

frame memory for storing a reference frame;

demultiplexer for receiving and demultiplexing said encoded data into motion information and current frame information;

motion compensation predictor coupled to said demultiplexer and said frame memory for receiving said motion information and constructing a prediction of the current block based on said motion information and reference frame;

transformer coupled to said motion compensation predictor for creating a plurality of transform coefficients;

quantizer coupled to said transformer for quantizing said plurality of coefficients;

adder coupled to said quantizer and said demultiplexer for adding current frame information and said quantized plurality of coefficients to form a plurality of coefficients for a reconstructed frame;

inverse quantizer coupled to said adder; and

inverse transformer coupled to said inverse quantizer.

**[0095]** 11. The decoder of claim 10, wherein normalizer is coupled to said demultiplexer, said normalizer for normalizing current frame data.

**[0096]** 12. The decoder of claim 11, wherein adder coupled to said quantizer and said normalizer, and said transformer for adding normalized current frame information and said plurality of transform coefficients.

**[0097]** 13. A method for decoding a frame of video data, comprising the steps of:

forming a prediction of a current block of data using a plurality of motion vectors and a reference frame creating a predicted block;

calculating a plurality of transform coefficients  $c_{sub.pred}$  from said predicted block;

calculating a plurality of quantized reconstruction coefficients  $l_{sub.rec}$  for said current block of data using

$$l.sub.rec = (c.sub.pred \times A(QP1) + l.sub.err \times F(QP1, QP2) + f \times 2^{20}) // 2^{20}$$
, wherein  $F(QP1, QP2) = (2^{20} \times A(QP1) + 0.5 \times A(QP2)) // A(QP2)$ ;

dequantizing said plurality of quantized reconstruction image coefficients, creating a plurality of dequantized coefficients d.sub.rec; and

inverse transforming said plurality of dequantized coefficients.

**[0098]** 14. A method for decoding a frame of video data, comprising the steps of:

forming a prediction of a current block of data using a plurality of motion vectors and a reference frame creating a predicted block;

calculating a plurality of transform coefficients c.sub.pred from said predicted block;

calculating reconstruction image coefficients c.sub.rec wherein

$c.sub.rec = c.sub.pred + \alpha(QP2) \times l.sub.err$ , wherein  $\alpha(QP2)$  is a quantization parameter dependent on the method of quantization and used QP value; and

quantizing said reconstruction coefficients creating a plurality of quantized reconstructed image coefficients l.sub.rec;

dequantizing said plurality of quantized reconstruction image coefficients, creating a plurality of dequantized coefficients d.sub.rec; and

inverse transforming said plurality of dequantized coefficients.

**[0099]** 15. The methods of claim 13 or 14, further comprising the step of normalizing said plurality of inverse transformed dequantized coefficients.

**[00100]** 16. The method of claim 15, further comprising the step of filtering said plurality of normalized inverse transformed dequantized coefficients.

**[00101]** 17. An encoder for encoding a frame of video data, comprising the steps of:

means for forming a prediction of a current block of data using a plurality of motion vectors and a reference frame;

means for calculating a plurality of transform coefficients  $c_{sub.orig}$  for said current block of data corresponding to a set of basis functions;

means for calculating a plurality of transform coefficients  $c_{sub.pred}$  for said predicted block;

means for quantizing said predicted block coefficients using quantization parameter  $QP=QP1$  creating a plurality of quantized prediction image coefficients;  $l_{sub.pred}$ .

means for calculating the prediction error coefficients using

$$c_{sub.err} = c_{sub.orig} - l_{sub.pred} \times \alpha(QP1)$$

wherein  $\alpha(QP1) = (2^{20} + 0.5 \times A(QP1)) / A(QP1)$ ; and

means for quantizing said prediction error coefficients.

[00102]  
of:

18. A method for encoding a frame of video data, comprising the steps

forming a prediction of a current block of data using a plurality of motion vectors and a reference frame;

means for calculating a plurality of transform coefficients  $c_{sub.orig}$  for said current block of data corresponding to a set of basis functions;

calculating a plurality of transform coefficients  $c_{sub.pred}$  for said predicted block;

quantizing said predicted block coefficients using quantization parameter  $QP=QP1$  creating a plurality of quantized prediction image coefficients  $l_{sub.pred}$ ;

calculating the prediction error coefficients using:

$$c.sub.err = c.sub.orig - l.sub.pred \times \alpha(QP1); \text{ wherein}$$
$$\alpha(QP1) = (2^{20} + 0.5 \times A(QP1)) / A(QP1); \text{ and}$$

quantizing said prediction error coefficients.

**[00103]** 19. A method for switching between a plurality of bitstreams in a data communication system, wherein said bitstreams correspond to a same data sequence but are encoded at different bitrates, said method comprising the steps of:

placing a first SP-picture within a first bitstream in a location at which switching from a second bitstream to said first bitstream is desired;

transmitting a second SP-picture wherein said first SP-picture and said second SP-picture are represented by different bitstreams, but wherein said first SP-picture reconstructed values and said second SP-picture reconstructed values are identical.

**[00104]** 20. A method for enabling access in a data stream, said method comprising the steps of:

placing a plurality of SP-pictures at fixed intervals within a first bitstream;

generating an I-picture and an SP-picture for each one of said plurality of SP-pictures in said first bitstream;

storing said I-picture in a second bitstream at a temporal location preceding said each one of said plurality of SP-pictures in said first bitstream; and

storing said SP-picture in said second bitstream at same temporal locations as each of said SP-pictures in said first bitstream.

**[00105]** 21. The method of claim 20, wherein said second bitstream comprises only SP-pictures predicted from each other, but at longer temporal periods.

**[00106]** 22. The method of claim 20, wherein said first bitstream comprises only SP-pictures predicted from each other, but at longer temporal periods.

**[00107]** 23. A method for providing Video Redundancy Coding (VRC), comprising the steps of:

dividing a sequence of pictures into a plurality of threads wherein all pictures are assigned to one of said plurality of threads in a round-robin fashion;

coding each of said plurality of threads independently;

creating a SP-picture, wherein all of said threads converge; and

starting a second plurality of threads from said SP-picture.

**[00108]** 24. A method for providing error control in a data stream between a sender and a client in a communication system, said method comprising:

creating a plurality of representations of a picture in the form of a plurality of SP-pictures predicted from different reference pictures;

signaling said sender information regarding lost pictures and a one of said plurality of representations received by said client; and

sending said client a SP-picture which is the next picture in said one of plurality of representations received by client.

**[00109]** 25. A method of reconstructing blocks of encoded data comprising the steps of:

forming a prediction  $P(x,y)$  of a current block using a plurality of received motion vectors and a reference frame;

performing a forward transform on  $P(x,y)$  to obtain a set of transform coefficients  $c.sub.pred$  for  $P(x,y)$ ;

quantizing said set of transform coefficients  $c.sub.pred$ , resulting in quantized prediction image coefficients  $l.sub.pred$ .



adding said received quantized coefficients for the prediction error l.sub.err to l.sub.pred resulting in quantized reconstruction image coefficients l.sub.rec using:

$$l.sub.rec = l.sub.pred + (\text{beta}(QP2) \times l.sub.err + 0.5 \times \text{beta}(QP1)) // \text{beta}(QP1).$$

wherein beta(QP) is a parameter dependent on method of quantization and used QP value;

dequantizing l.sub.rec resulting in dequantized coefficients d.sub.rec;  
and

performing inverse transform for d.sub.rec.

**[00110]** 26. The method of claim 25, further comprising the step of normalizing said plurality of inverse transformed dequantized coefficients.

**[00111]** 27. The method of claim 26, further comprising the step of filtering said plurality of normalized inverse transformed dequantized coefficients.